Shoreline Protection

using a soft approach

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Outline of our talk

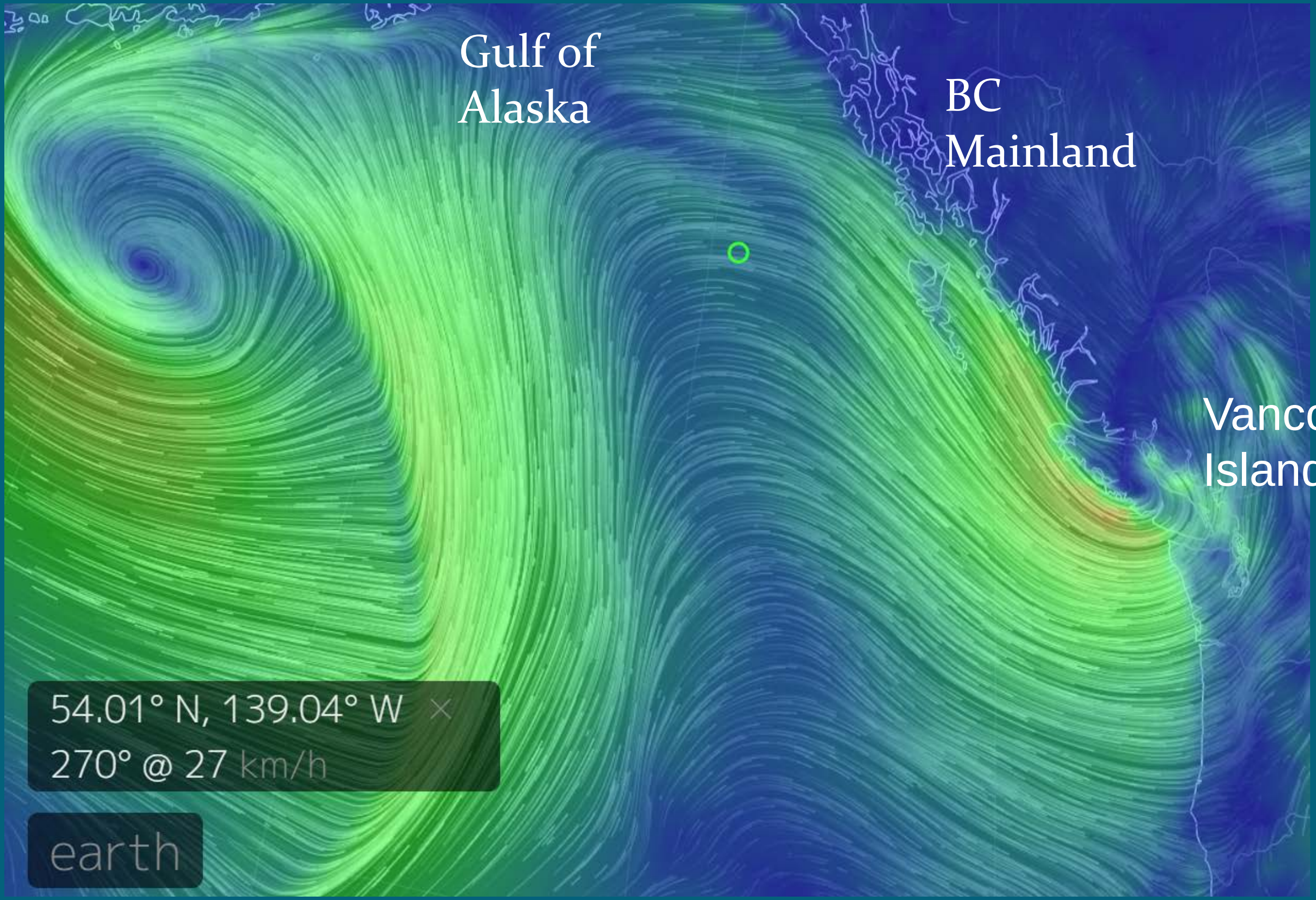
- Who were are and what we do
- Physical and biological setting of the Salish Sea
- Factors contributing to shoreline erosion
- Traditional engineering methods
- Soft approaches to shoreline protection
- Future threats-sea level rise and climate change

Physical setting

Important factors controlling shoreline erosion:

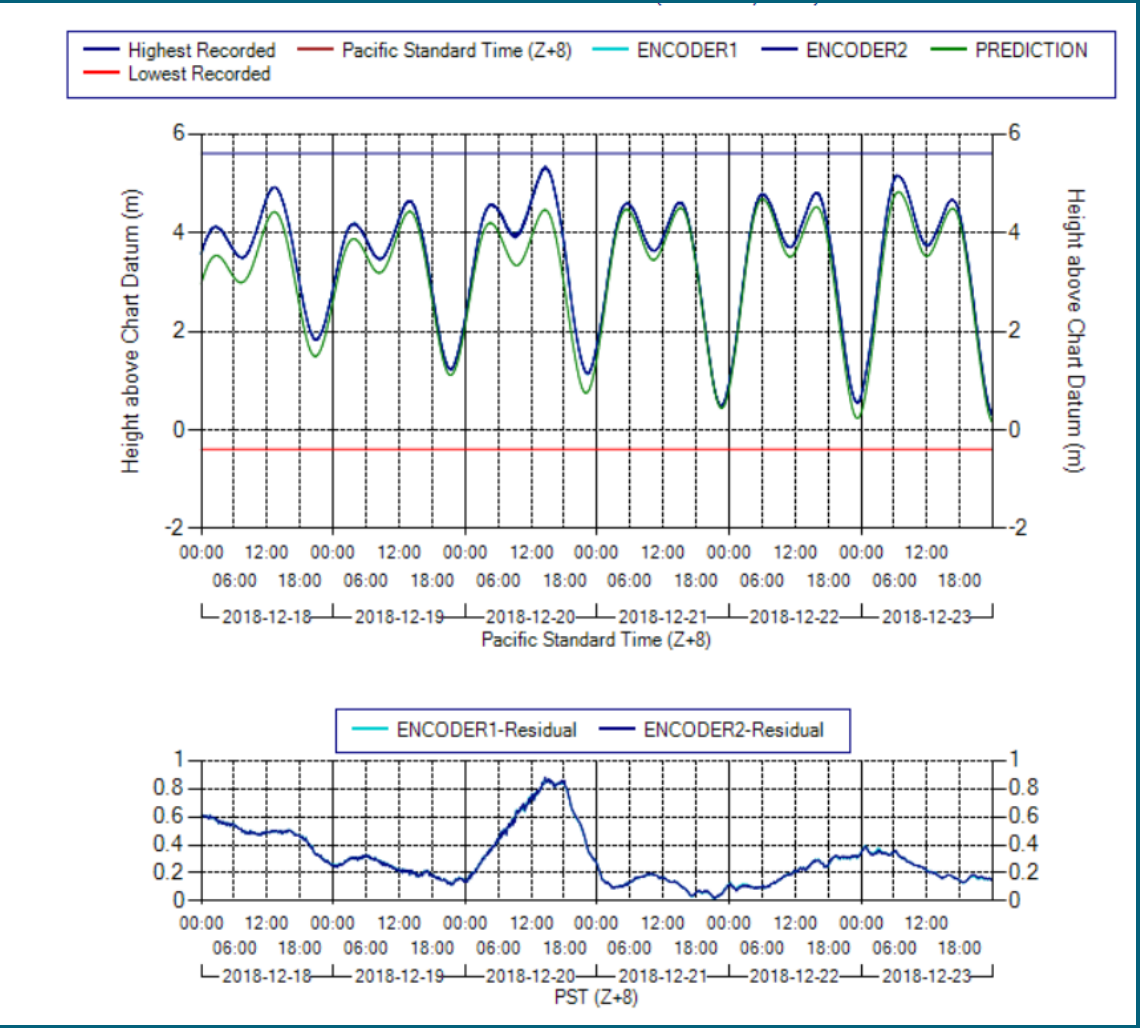
1. Astronomical tides
2. Storm surge
3. Waves
4. Shoreline geology

December 20 218 storm



surface wind pattern

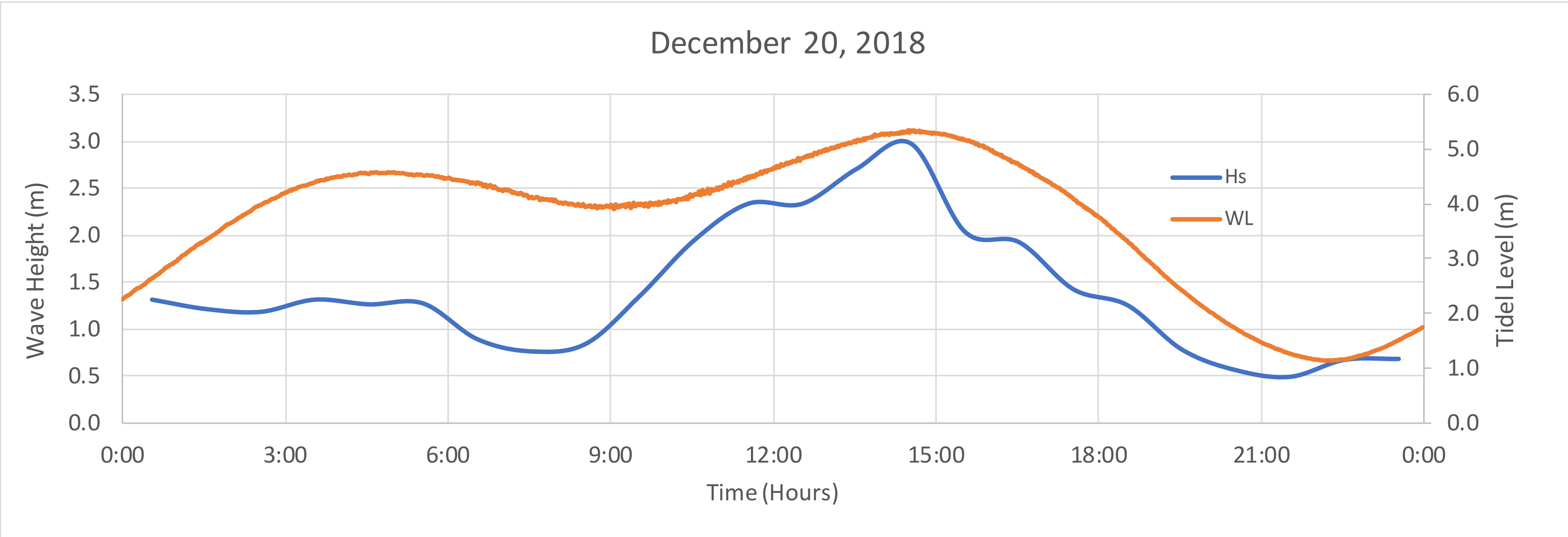
Storm surge raised ocean level by nearly 1 m during December storm



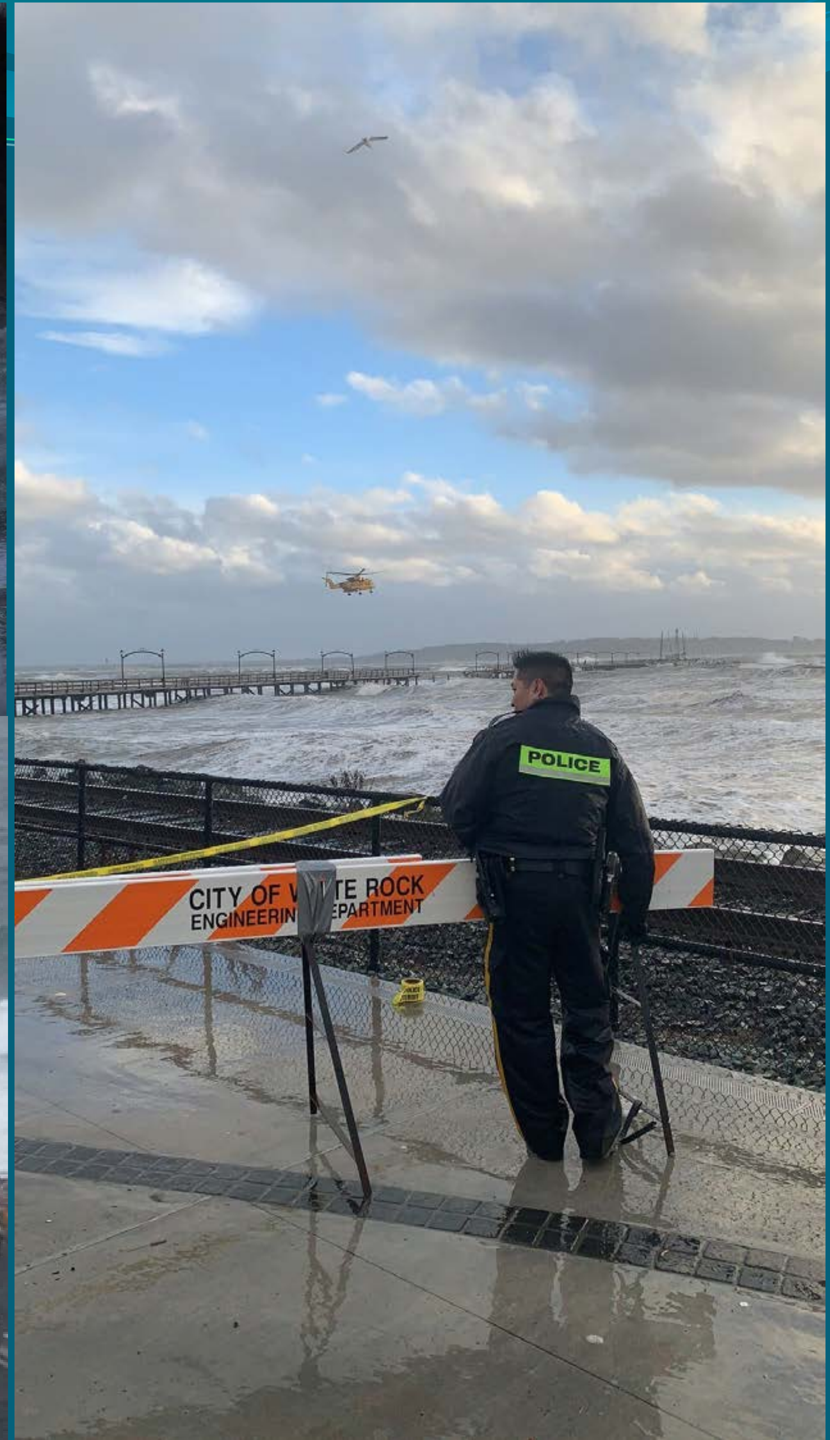
Observed tide and astronomical tide at Point Atkinson

Storm surge observed at Point Atkinson

Timing of high tide coincided with peak of storm



Note that highest tide happened to coincide with the maximum wave heights, producing the most severe condition for generating shoreline erosion


POLICE

Hazards from shoreline erosion

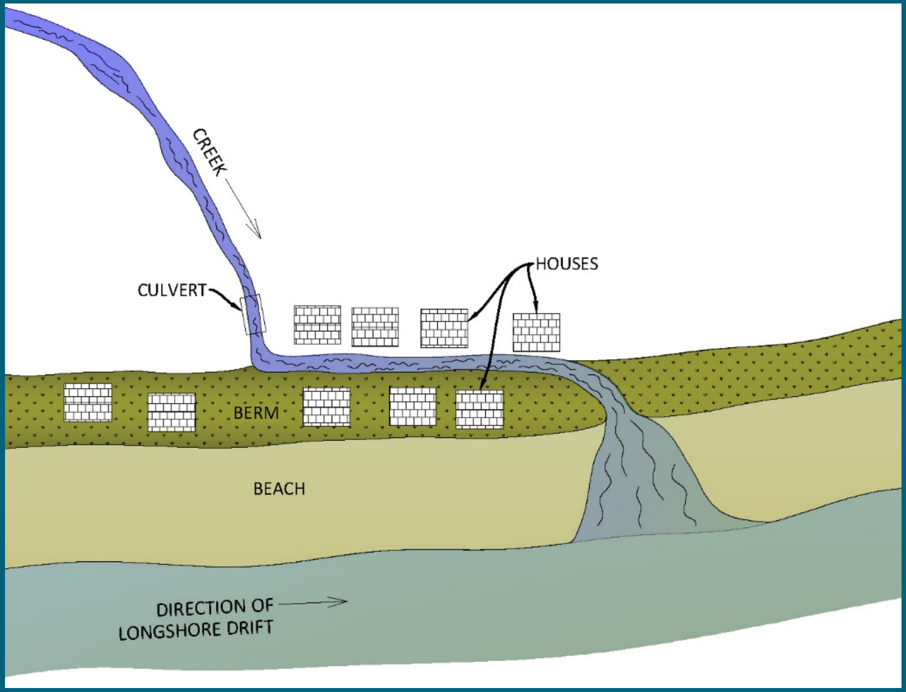
1. The greatest threat of erosion occurs when winter storms coincide with high tides + storm surge.
2. Easily erodible beach sediments (for example, wind-blown dune deposits at spits)
3. When homes & infrastructure have inadequate set-back distance and are constructed too low to avoid wave runup.
4. Special geomorphic features-eg, Barrier Beaches combine fluvial and coastal processes

Special hazards-barrier beaches

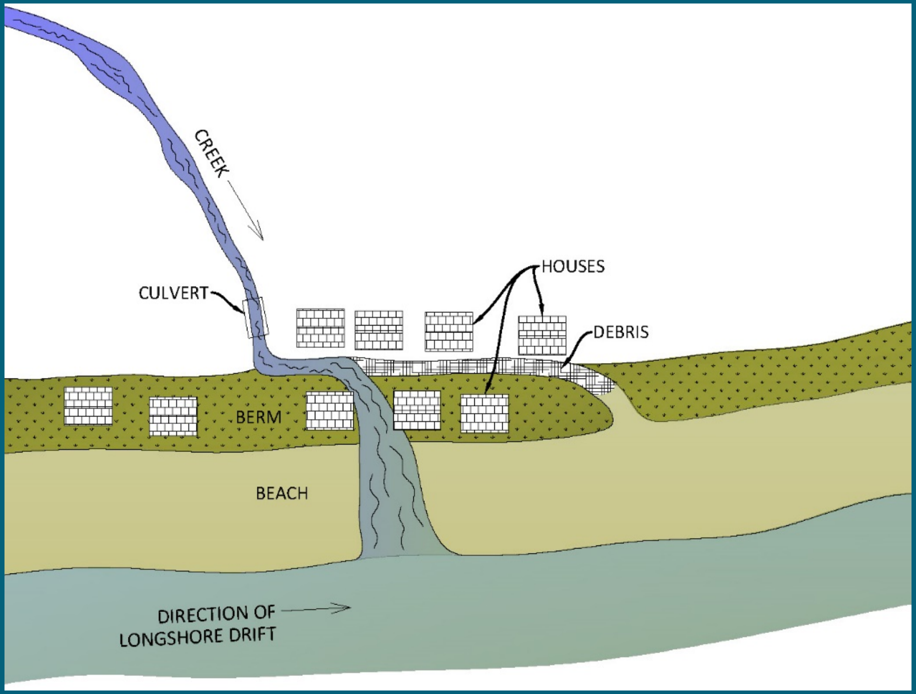
Erosion hazard occurs near the point where a creek meets the shoreline. Hazard is greatest when houses are constructed on the shoreline's natural berm and the beach has high rates of longshore transport

Erosion at a barrier beach can be rapid (few hours)

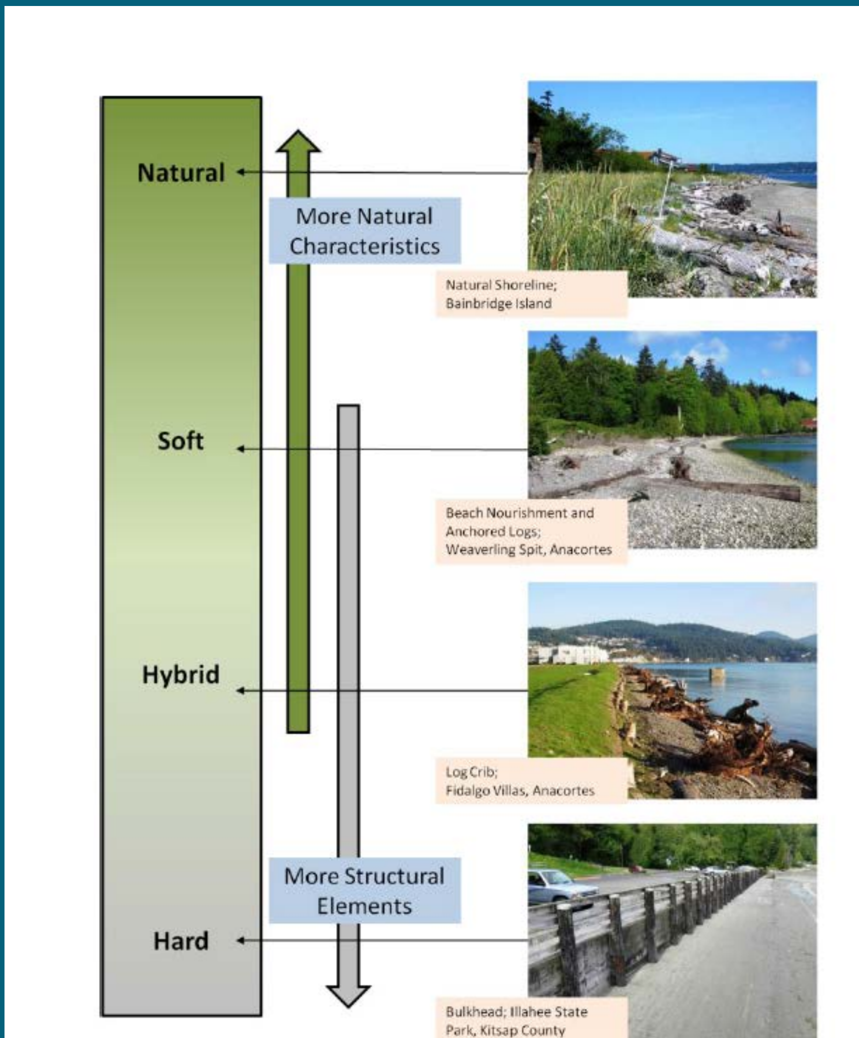
Before



After



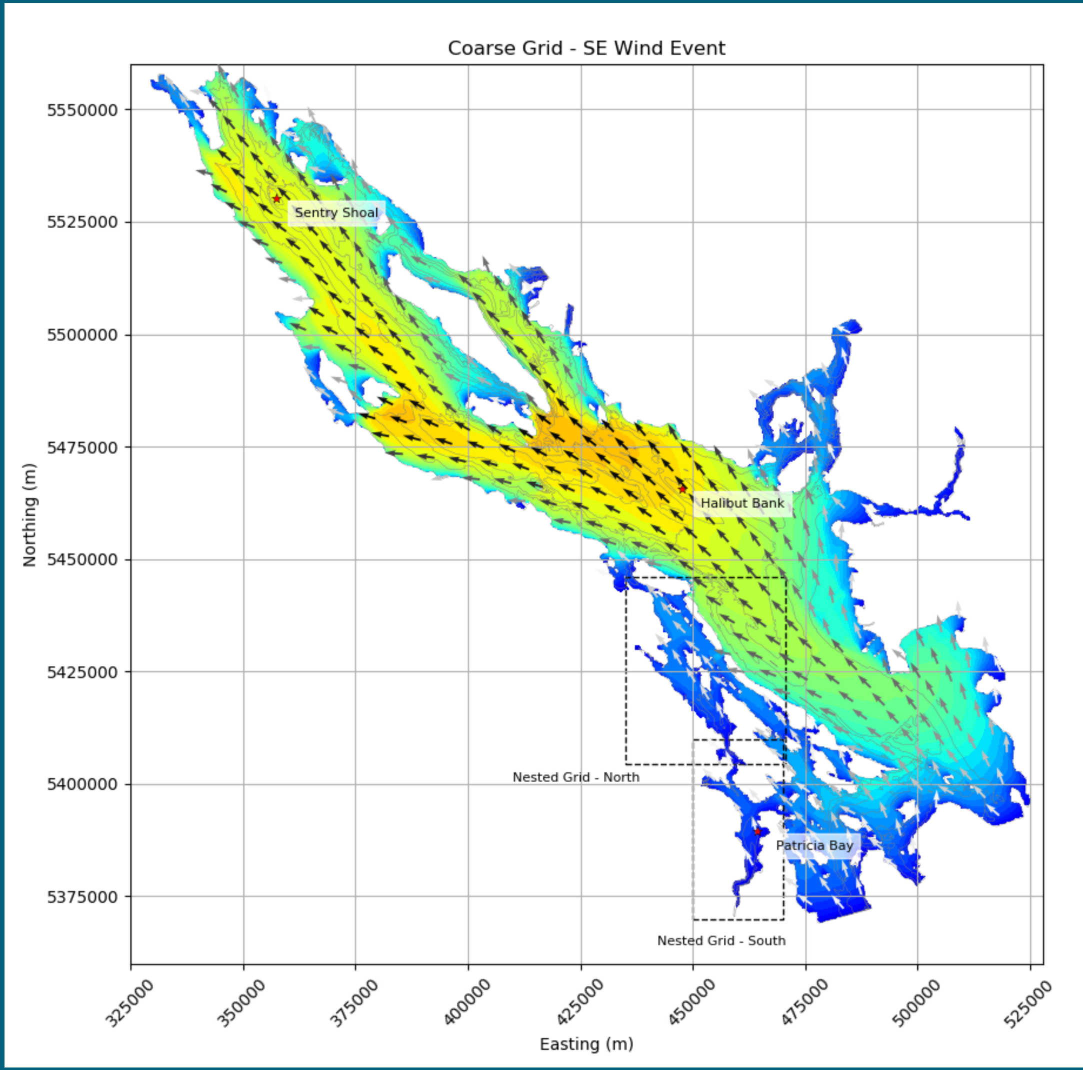
Shoreline protection-evolution of approaches, “hard” versus “soft”



Potential impacts of shoreline protection:
Loss of upper beach and backshore
Modifies aquatic-terrestrial connectivity
Passive erosion
Alters sediment supply & longshore transport
Alters wave field, reflection, scour

From WSDE, 2014

Impact of storms depend on exposure and local geomorphology



Wave Height (m)	Stable Stone Mass (kg)
0.3	2
1.0	80
2.0	700

Soft shoreline protection

Soft shore stabilization
Bioengineering
Living shorelines
Green Shorelines
“Environmentally friendly” stabilization

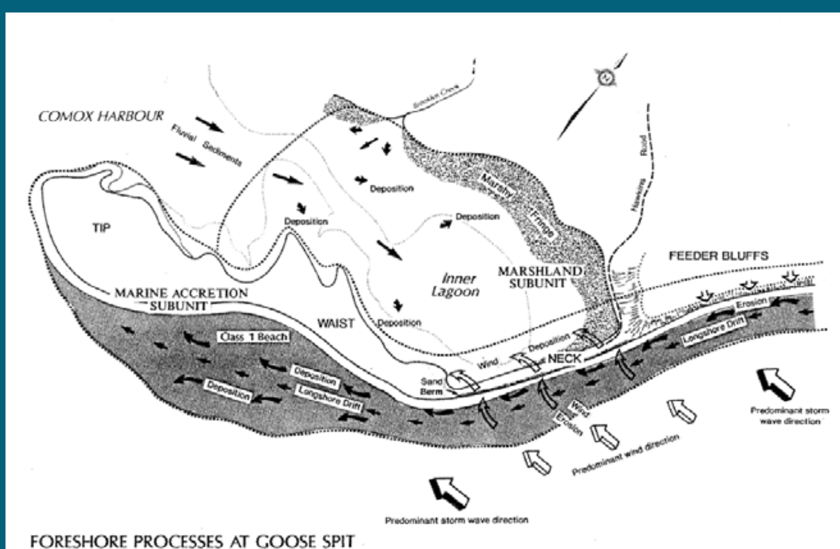
Soft shoreline stabilization projects attempt to balance the need to control erosion while also maintaining and enhancing shoreline ecological function (WSDE, 2014)

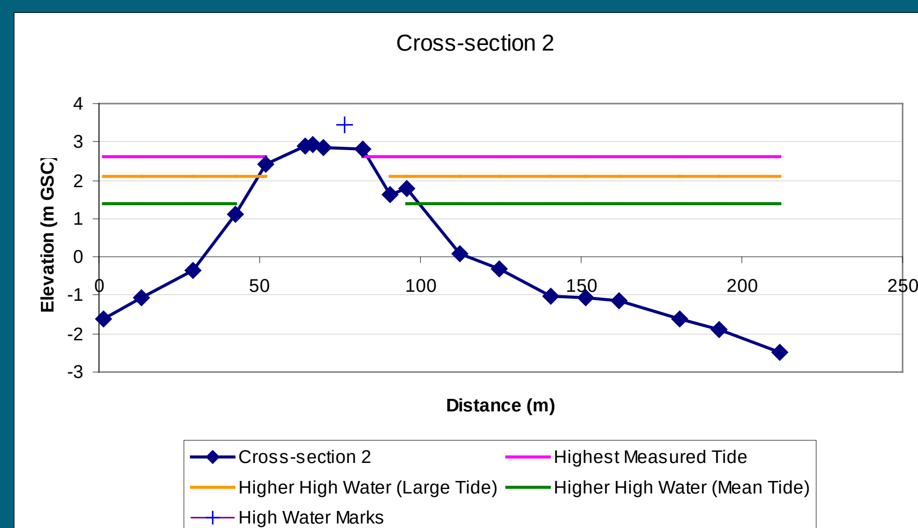
Challenges to implementing soft shoreline protection methods

1. Risk aversion of land-owners and engineers
2. Limited engineering guidelines and technical specifications available for designing soft shoreline protection. To-date, mostly done using the "learning by doing" approach.
3. Maintenance often likely to be more frequent than traditional hard methods
4. Widespread installation of hard protection on nearby or adjacent properties. Its difficult to build short sections of new soft protection between existing hard protection
5. Consequences of failure may affect decision to use one approach

Low risk site for soft protection application

Example: considering coastal processes in planning and design





Effect of shoreline protection on coastal processes

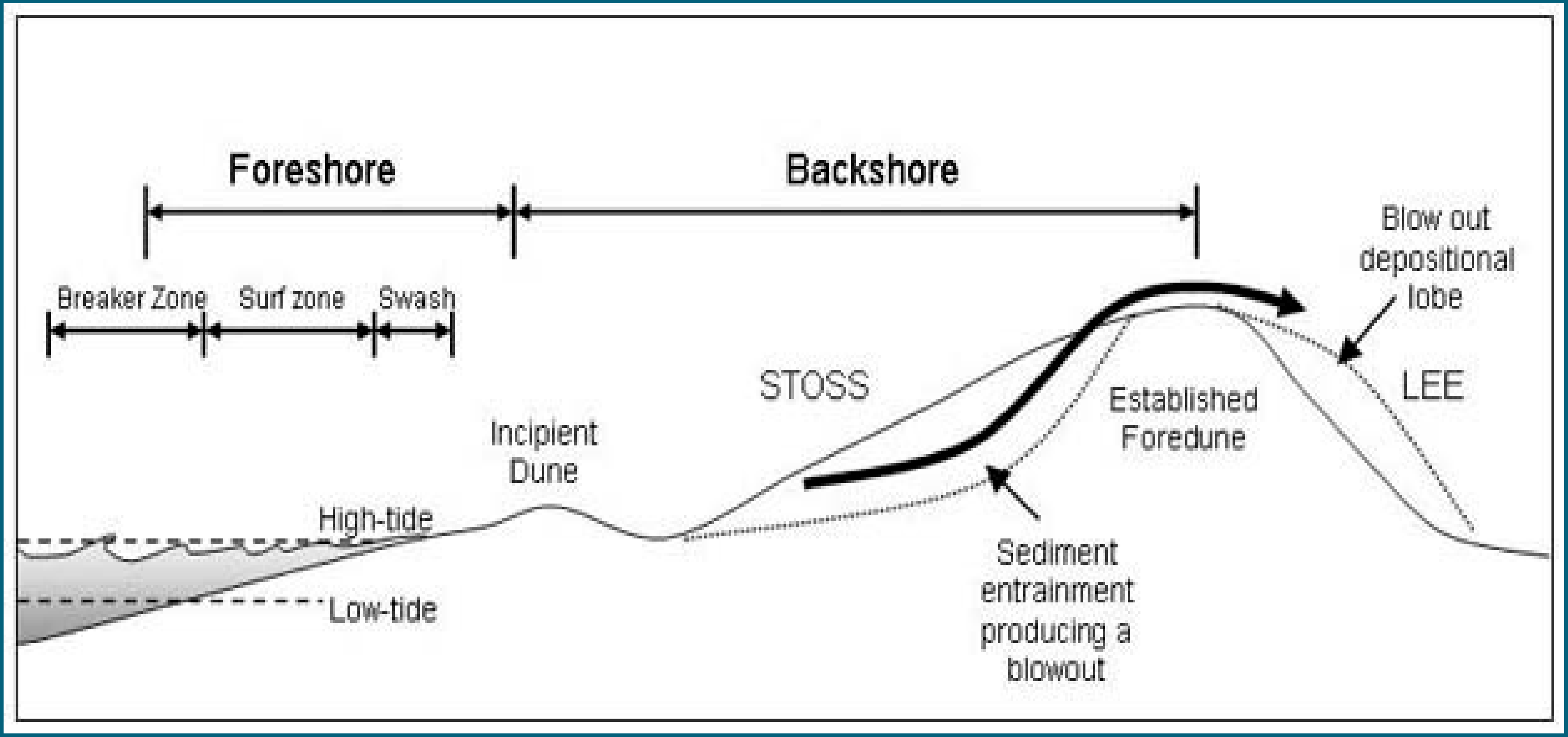
Feeder bluffs used to be important sediment source

Sediment supply reduced after installing riprap protection

Groynes

Coastal dunes-

2 main sediment transport processes:
-waves (longshore transport)
-winds (aeolian transport)



Local initiative to reduce spit erosion and overtopping

When to use soft design

- Suitable wave climate
- Protecting sensitive shoreline habitat
- Enhancing broader ecosystems (IBAs, forage fish habitat, salt marsh, sand ecosystems)
- Suitable beach profile & substrate

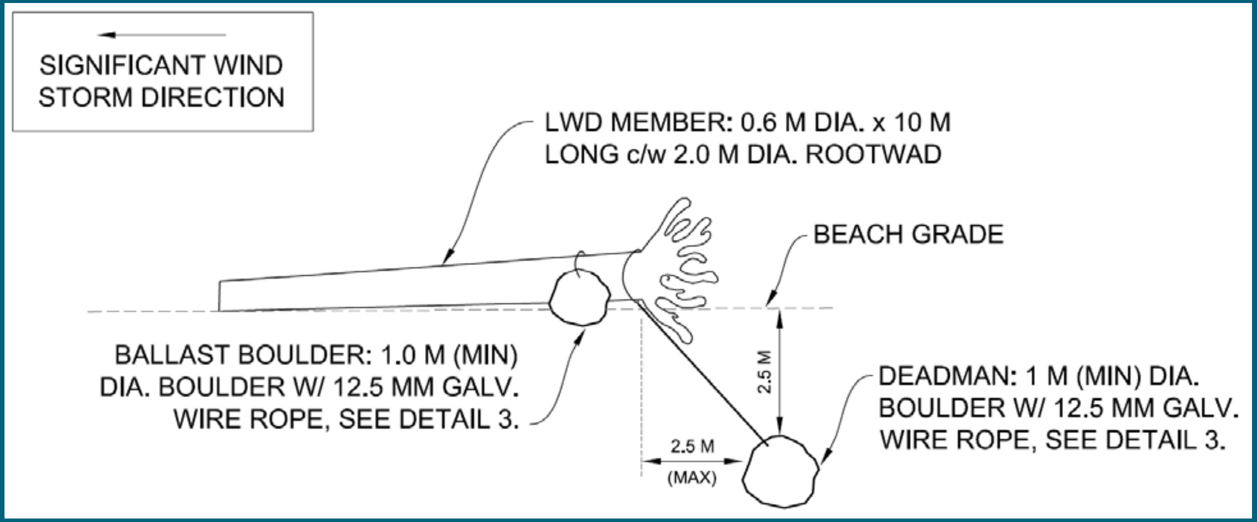
Natural stabilizers

Local case studies

- Kitty Coleman Provincial Park
- Kin Beach Provincial Park
- Rathtrevor Beach Provincial Park

Kitty Coleman (2009-2012)

Design & Implementation



Performance

Performance

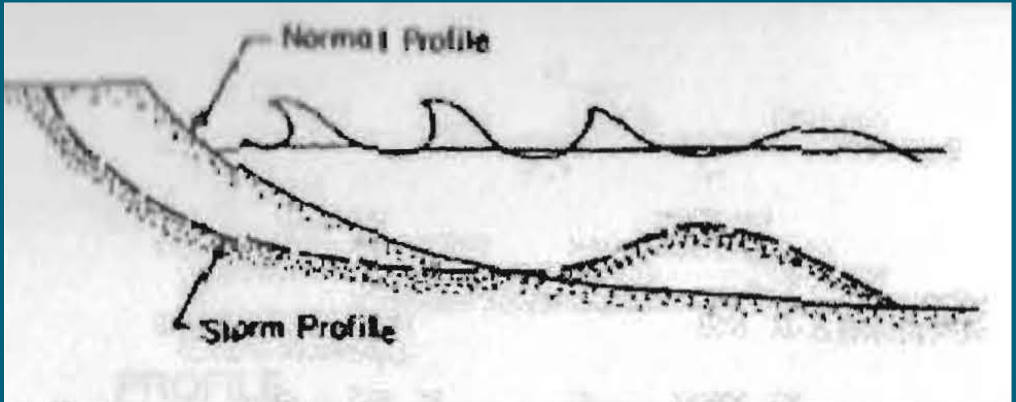
Accretion

- Re-establish shoreline communities
- Support forage fish breeding habitat

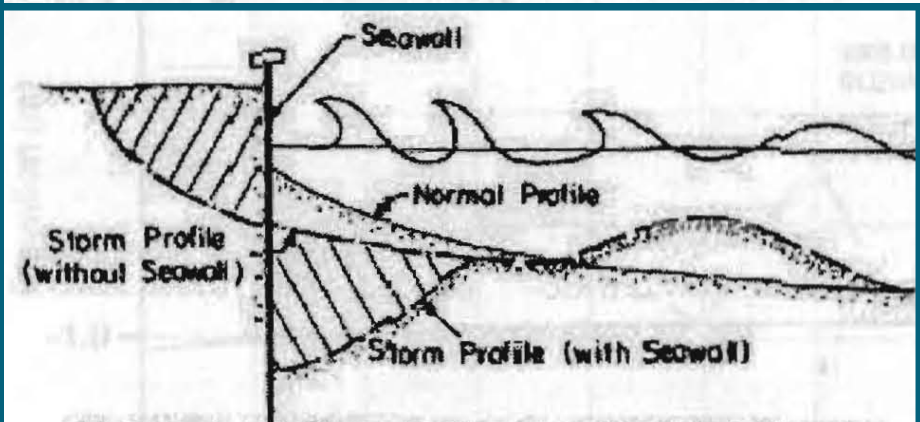
Wave Reflection

What the experts are saying…

- *COASTAL ARMORING THAT HARDENS THE SHORELINE TO A FIXED POSITION INDUCES SCOUR DUE TO WAVE REFLECTION AND AMPLIFICATION, WHICH CAN CAUSE LOWERING OF THE BEACH*



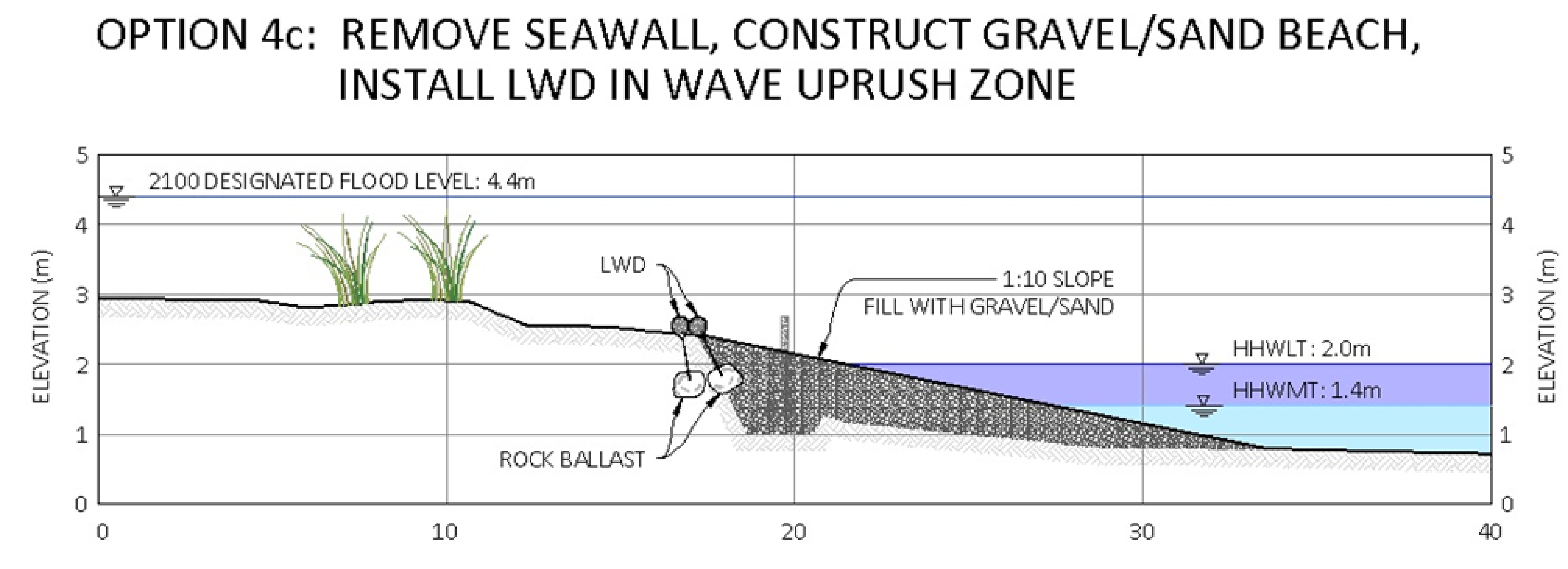
a) Normal and Storm Profiles on a Natural Shoreline



b) Normal and Storm Profiles on a Seawalled Shoreline and Comparison with Profiles on a Natural Shoreline

Rathtrevor Beach Provincial Park

Decommissioning relic features

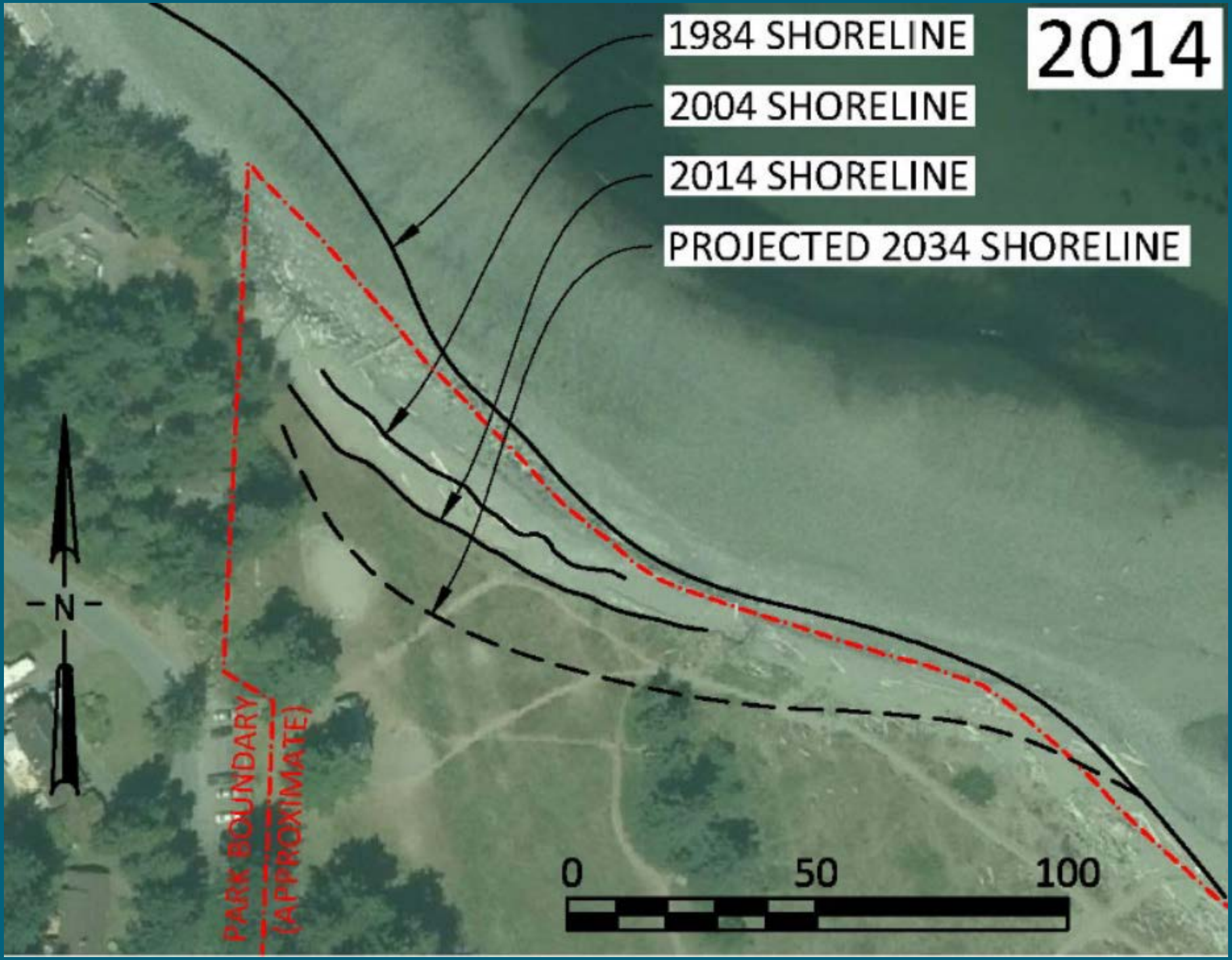


Rathtrevor beach restoration

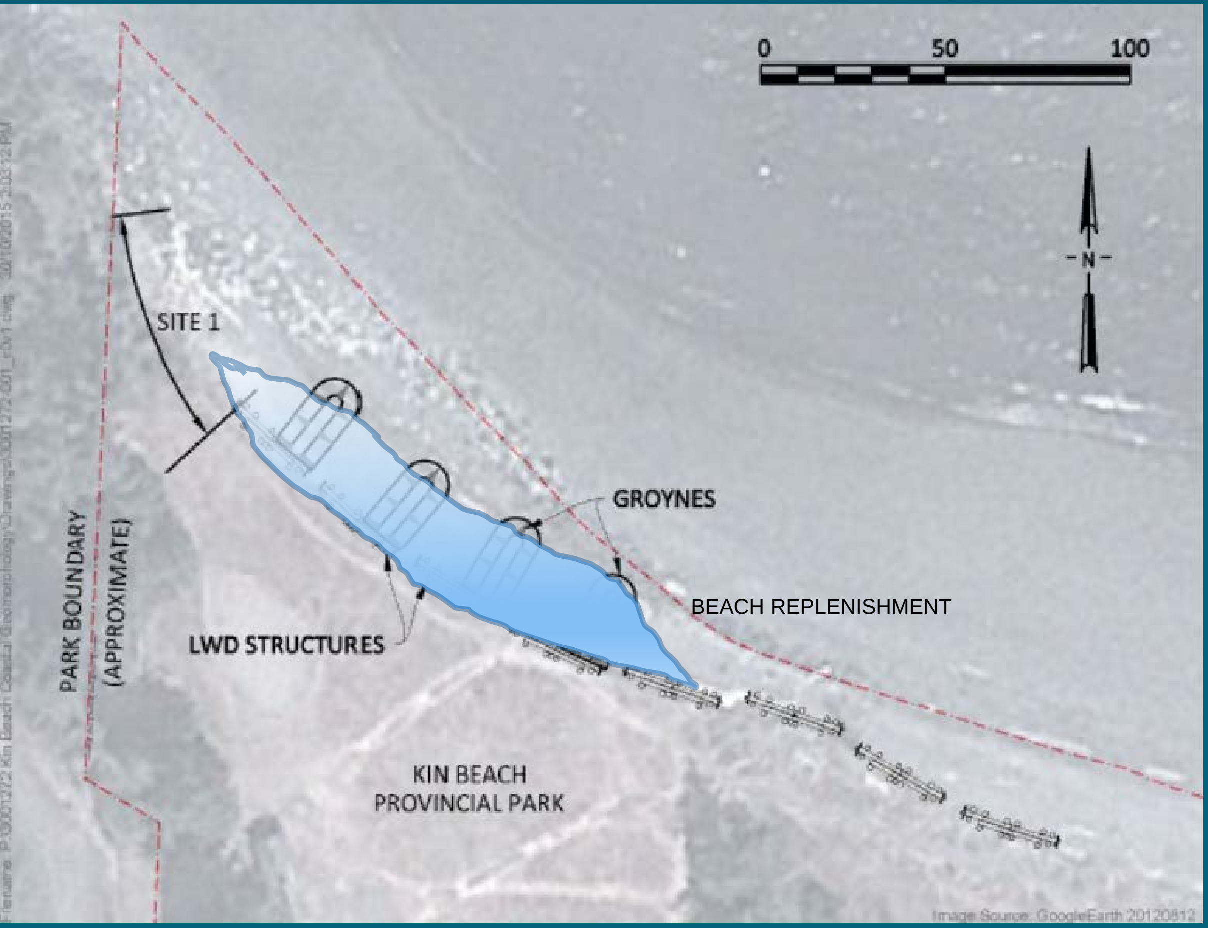
After

Before

Kin Beach Provincial Park



Kin Beach- Restoration Design



1. Anchored LWD on backsho
2. Gravel/cobble beach replenishment
3. Low boulder groynes

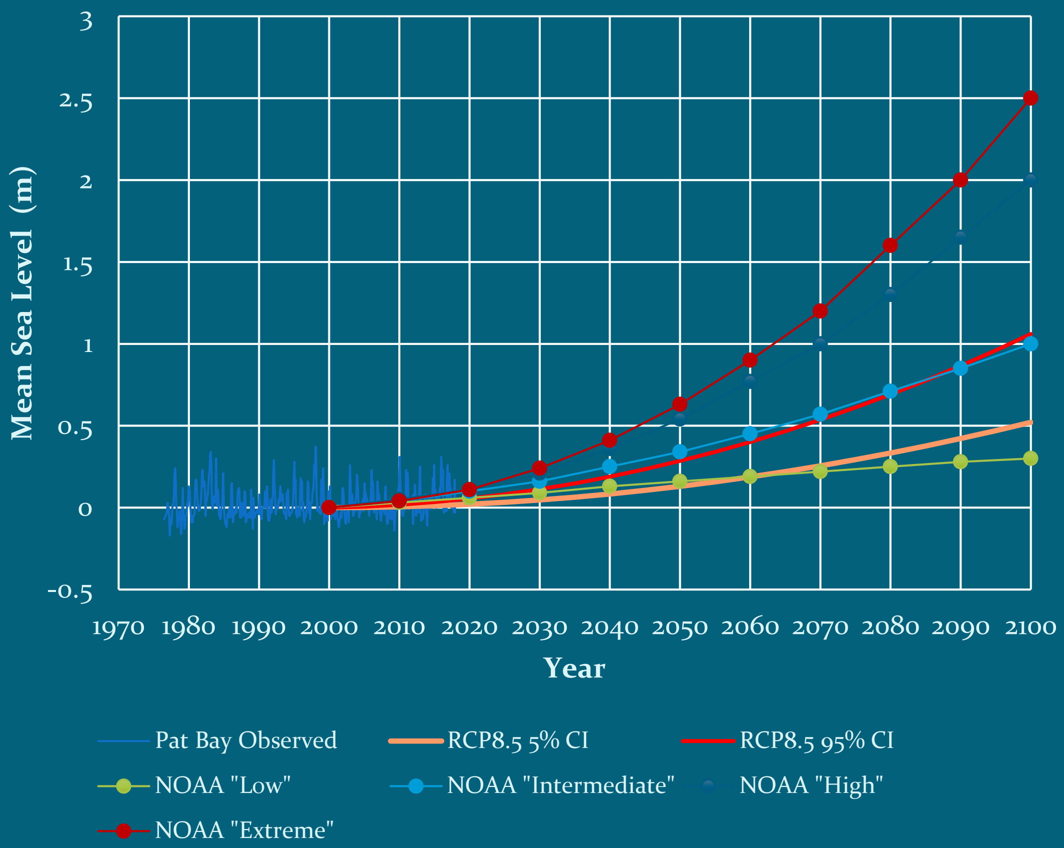
Kin Beach-before

Kin Beach-after

Future threats-climate change

Future Scenarios: Coastal Areas

NOAA (2017) projections for North America



Three adopted future scenarios:
Intermediate: 1.0 m
Intermediate-High: 1.5 m
Extreme: 2.5 m

Note:
No reduction for local tectonic effects


Extreme: 2.5 m SLR
Intermediate High: 1.5 m SLR
Intermediate: 1m SLR
Present Conditions

Coastal Flooding

Shoreline alteration